LESSON 3: THE GRID REFERENCE SYSTEM AND SIX-DIGIT GRID COORDINATE

PURPOSE

This lesson introduces you to the universal transverse mercator grid system and the military grid reference system. Once you are familiar with these systems and how mapmakers divide the globe into north-south and east-west rings, you will better understand how to locate and identify points anywhere in the world. From this very broad perspective, this lesson will then show you how to locate a point on a map to within 100 meters using a six-digit **grid coordinate**.

coordinate scale
grid coordinate
grid lines
grid squares
increments
intersects
latitude
longitude
meridians
prime meridian
superimposed
Universal Mercator System

INTRODUCTION

To keep from getting lost, you must know how to find your location. Street addresses may not always be available to you. Learning to use the grid referencing system in conjunction with maps will help you to quickly and accurately pinpoint your location.

LINES OF LATITUDE AND LONGITUDE

By drawing a set of east-west rings around the globe (parallel to the equator), and a set of north-south rings crossing the equator at right angles and converging at the poles, mapmakers can form a network of reference lines from which you can locate any point on the earth's surface — see Illustration 2.3.1.

We refer to the distance of a point north or south of the equator as its **latitude** and the rings around the earth parallel to the equator as parallels of latitude, or simply parallels. *Lines of latitude run east-west, but we measure north-south distances between them*. Starting with zero degrees at the equator, mapmakers number parallels to 90 degrees both north and south.

We refer to a second set of rings around the globe that are at right angles to the lines of latitude and that pass through the poles as **meridians** of **longitude**, or simply meridians. One meridian is the **prime meridian**, which runs through Greenwich, England. The distance east or west of the prime meridian to a point is known as its longitude. *Lines of longitude run north-south, but we measure east-west distances between them*. Starting with zero degrees at the prime meridian, mapmakers number meridians to 180 degrees both east and west.

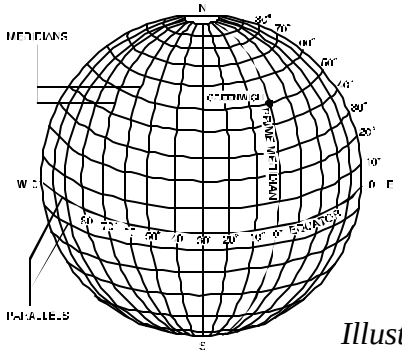


Illustration 2.3.1

UTM GRID SYSTEM

The U.S. military **superimposed** its grid reference system on the Universal Transverse Mercator Grid System, or UTM grid system. To better understand the military's grid reference system, you should have a basic knowledge of the UTM grid system.

The UTM grid system divides the surface of the earth into 60 north-south grid zones (each six degrees wide) like the one in Illustration 2.3.2. Mapmakers number these zones from west to east, 1 through 60, starting at the 180 degree meridian. The grid zone in Illustration 2.3.2 represents grid zone number 3.

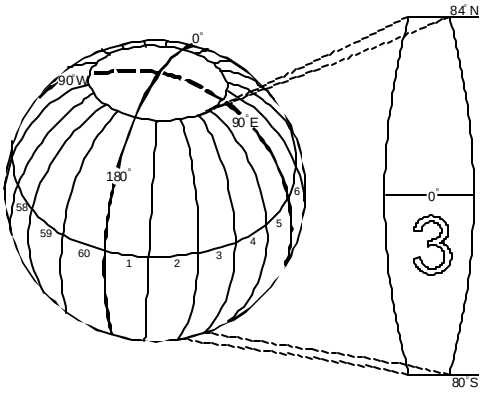


Illustration 2.3.2

Illustration 2.3.3 is this same grid zone, but now further divided into 20 north-south segments. We give each grid segment a letter for identification. Mapmakers use the letters "C" through "X" (omitting the letters "I" and "O") to identify these 20 grid segments. They do not use "I" and "O" because those letters can easily be mistaken for the numbers "1" and "0," respectively. Nineteen of these grid segments are eight degrees high and the one row at the extreme north is 12 degrees high. This combination of zone number and row letter constitutes the grid zone designation.

With this designator, we are now able to identify specific grids. For example, if we wanted to locate the first segment north of the equator, its grid zone designation would be 3N.

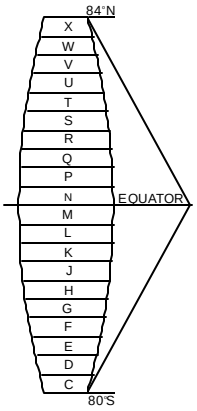


Illustration 2.3.3

However, if you were to cut out 60 shapes identical to those in Illustrations 2.3.2 or 2.3.3, your globe would not be complete at either end. Each of these 60 grid zones lay between the 84 degrees north and the 80 degrees south lines of latitude. The polar regions would be missing. Therefore, to complete your globe, extend these grid lines to 90 degrees in both directions: 90 degrees north latitude is the North Pole and 90 degrees south latitude is the South Pole. Mapmakers use the remaining four letters, "A," "B," "Y," and "Z" to identify the polar regions as shown in Illustration 2.3.4.

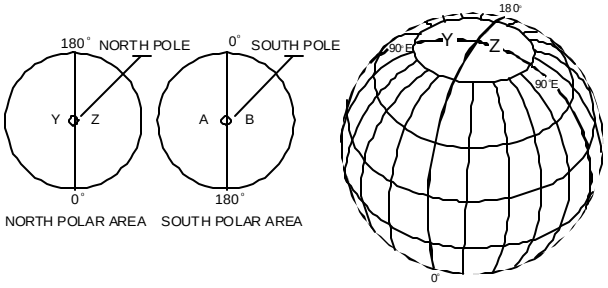


Illustration 2.3.4

MILITARY GRID REFERENCE SYSTEM

Superimposed on each grid zone segment are 100,000 meter squares. We identify each 100,000 meter square by two identification letters (see Illustration 2.3.5). The first letter is the column designation and the second letter is the row designation.

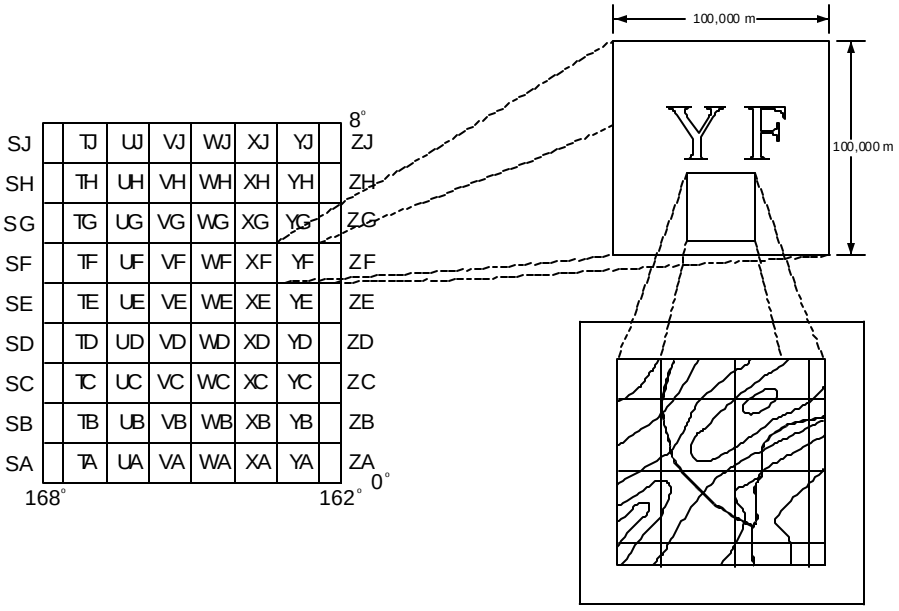


Illustration 2.3.5

We then further divide each 100,000 meter square by parallel lines (or **grid lines**) that are 1,000 meters or 10,000 meters apart (depending on the scale of the map). These parallel lines come together at right angles to form 1,000 meter or 10,000 meter squares (called **grid squares**) — see Illustration 2.3.6. These grid lines and grid squares are the lines that you see on a standard military topographic map. Mapmakers number grid lines along the outside edge of each topographic map for easy reference. Using the two 100,000 meter square identification letters in conjunction with these numbers, you can identify each grid square accurately, without any two grid squares having the same grid number (or grid coordinate).

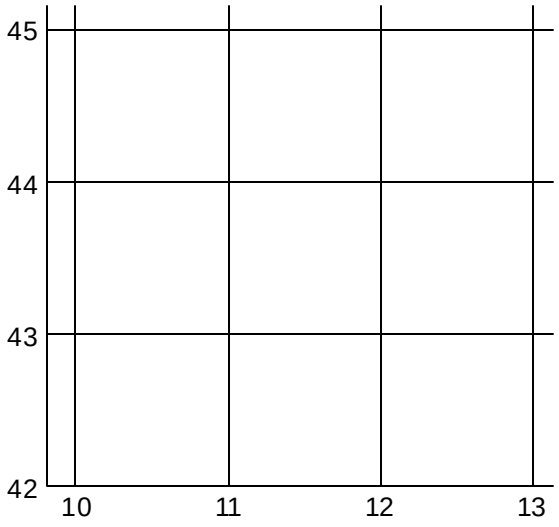


Illustration 2.3.6

LOCATING A POINT USING THE MILITARY GRID REFERENCE SYSTEM

Whenever you read a grid coordinate, you always read right first, then up. This is one of the cardinal rules in map reading. Based on this rule, you can determine locations on a map using grid coordinates. The number of digits in a grid coordinate represents the degree of precision to which you can locate and measure a point on a map — the more digits, the more precise the measurement. For example, a four-digit grid coordinate locates a point to within 1,000 meters, a six-digit grid coordinate to within 100 meters, and an eight-digit grid coordinate to within ten meters.

You write grid coordinates as one continuous alphanumeric symbol without spaces, parentheses, dashes, or decimal points. Further, grid coordinates must always contain an even number of digits, both letters and numbers. In order to determine grid coordinates without using a protractor, the reader simply refers to the grid lines numbered along the margin of any map. The following example shows how to form a four-digit grid coordinate.

Suppose you want to locate *Spot Elevation 450* in Illustration 2.3.7 to the nearest 1,000 meters.

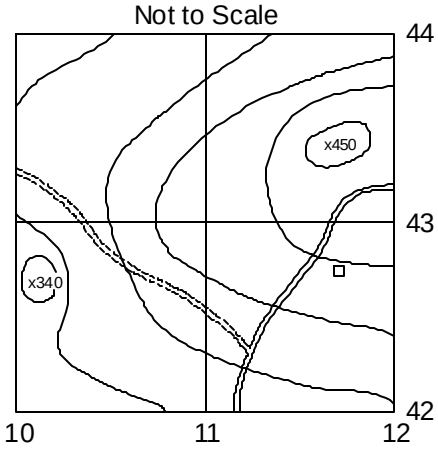


Illustration 2.3.7

1. Identify the 100,000 meter square identification letters for the map you are using. You can find this identification in the Grid Reference Box located at the bottom center of the lower margin of a topographic map. For this example, we will continue to use the "YF" identifier from Illustration 2.3.5.

Note: The next two steps would normally be to break down the 100,000 meter square into 10 equal 10,000 meter grid squares, then to further break down one of those into 10 equal 1,000 meter grid squares. However, we will omit these steps since our example already has 1,000 meter grid squares.

1. Identify the 1,000 meter grid square in which the spot elevation is located. To do this, remember the first cardinal rule of map reading: read right, then up. When reading a map right and up, each north-south grid line increases in value from west to east, and each east-west grid line increases in value from south to north.

2. Read right. We see that the last north-south grid line before reaching the grid square containing *Spot Elevation 450* is 11.

3. Read up. Note that the last east-west grid line before reaching the grid square containing *Spot Elevation 450* is 43.

4. Combine these steps by writing the 100,000 meter square identifier (YF) and the coordinates of the 1,000 meter grid square (11 and 43) as one continuous symbol. Thus, you would write this grid coordinate as YF1143. You have now correctly located a point on the map (*Spot Elevation 450*) to the nearest 1,000 meters and written a four-digit coordinate.

LOCATING A POINT USING SIX-DIGIT GRID COORDINATES

To locate a point to within 100 meters, follow the procedures in the previous lesson, and add one more step. In this step, you must divide the 1,000 meter grid square into tenths, or 100 meter **increments**. Illustration 2.3.8 shows what a 1,000 meter grid square would look like if you divided it into 100 meter segments.

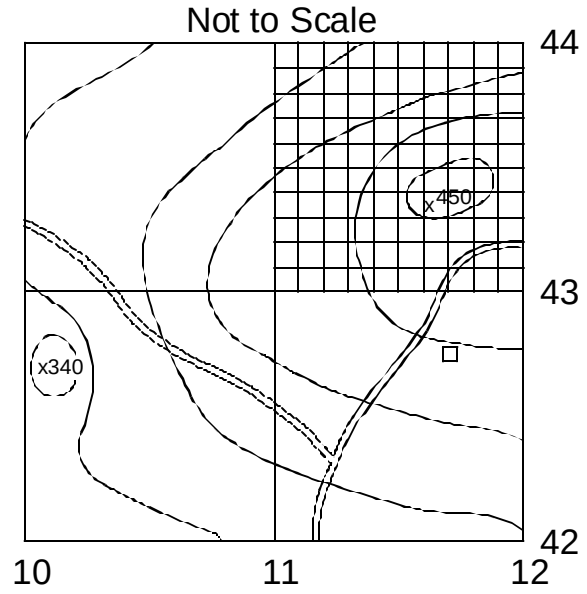


Illustration 2.3.8

Suppose we now want to again locate *Spot Elevation 450*, but this time to within 100 meters. First, read right. *Spot Elevation 450* is approximately six-tenths into the grid square. The right reading then is the value of the last north-south grid line before reaching this grid square, or 11, plus a 6 for the six-tenths. We would read this value as 116.

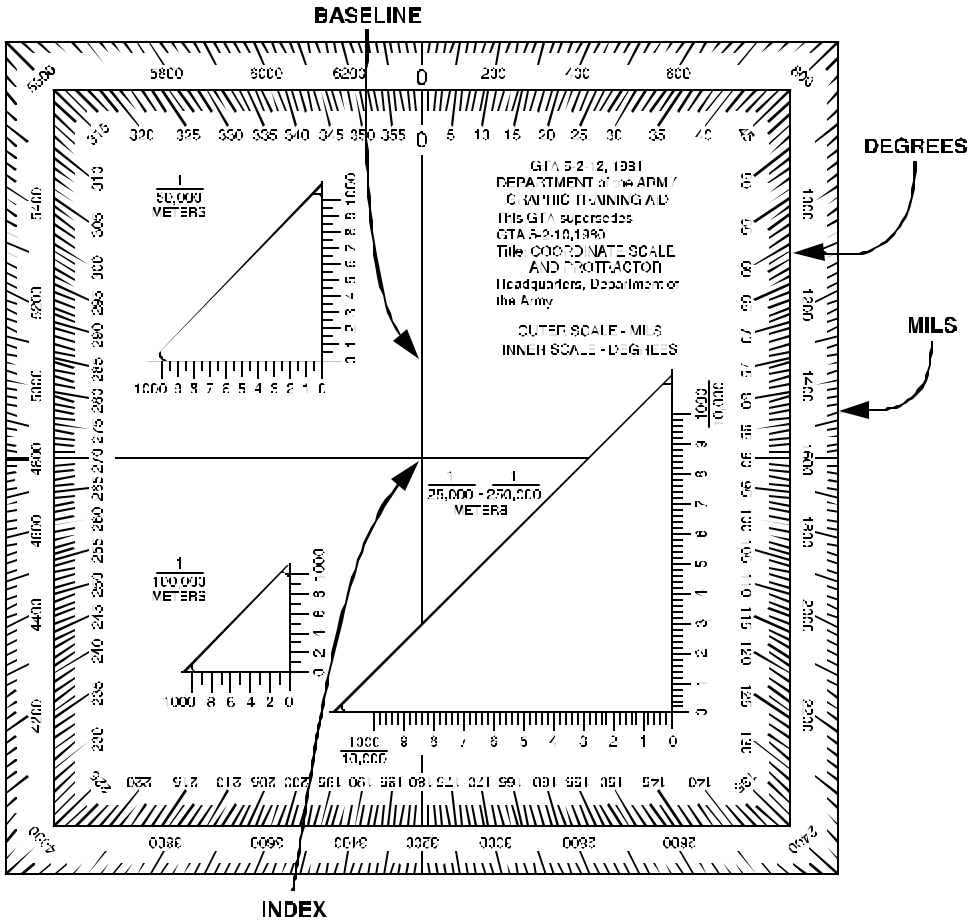
By reading up, you can see that *Spot Elevation 450* is approximately four-tenths of the way up into the grid square. Therefore, the up reading is the value of the last east-west grid line before reaching this grid square, or 43, and a 4 for the four-tenths. We would read this value as 434.

Combining both of these numbers and the 100,000 meter square identifier labels the location as YF116434 for *Spot Evaluation 450*. You have now used one method to locate a point to the nearest 100 meters by using a six-digit grid coordinate.

USING A COORDINATE SCALE

Another way to locate a point to within 100 meters is to make use of a coordinate scale. The following is the correct way to use a coordinate scale. To explain this procedure, we will once again find the six-digit grid coordinate for *Spot Elevation 450*.

The coordinate scale used by the Army is the one shown on the next page. Note that in the center, it has three different scales: 1:100,000 meters, 1:50,000 meters, and 1:25,000 meters (or 1:250,000 meters).



First, check to ensure that you are using the correct scale. (**Note:** If you obtained a coordinate scale from the JROTC instructor staff, use the 1:25,000 scale for Illustrations 2.3.9 and 2.3.10.) Place the horizontal scale parallel to and directly on top of grid line 43 with the "0 mark" at the lower left-hand corner of grid square YF1143 (see Illustration 2.3.9).

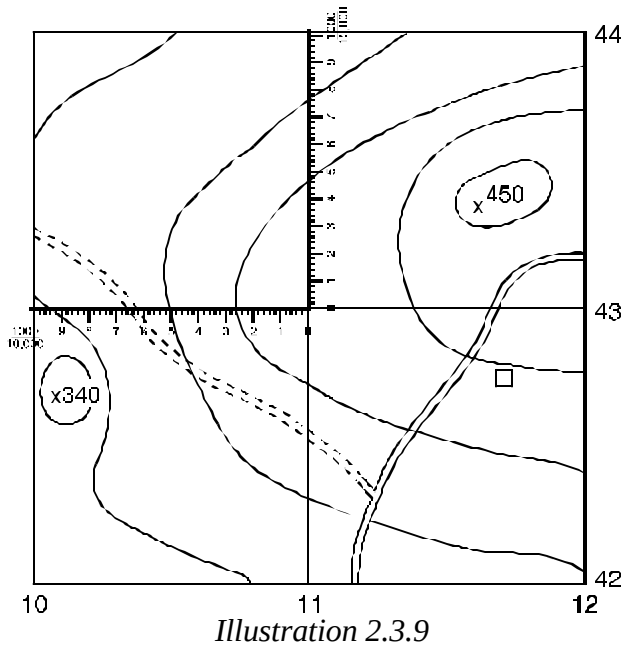


Illustration 2.3.9

Keeping the horizontal scale on top of the 43 grid line, slide the scale to the right into the grid square until the vertical scale **intersects** the center of mass of *Spot Elevation 450* (see Illustration 2.3.10).

Now, reading left from the "0 mark," you can see that *Spot Elevation 450* lies almost directly on the six-tenths indicator. Therefore, we would read this number as 116. (**Note:** When you have to round off numbers using a coordinate scale for a six-digit coordinate, apply the following rule: *round down for numbers that are four or less; round up for numbers that are five and above.*)

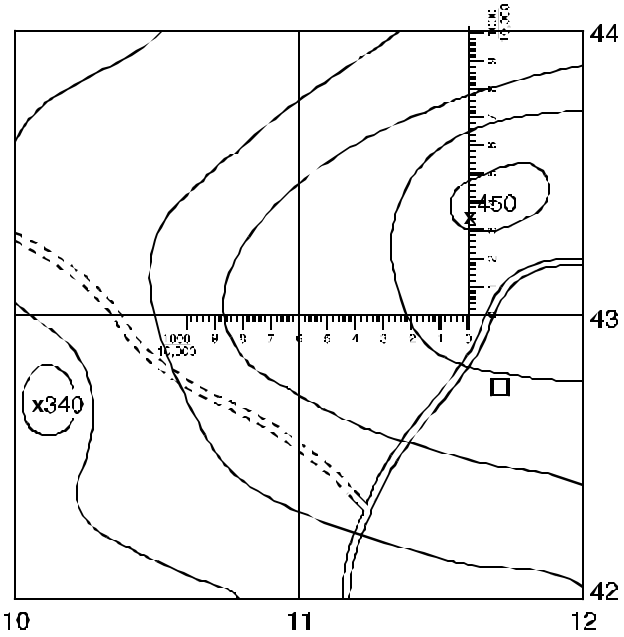


Illustration 2.3.10

Reading up, you can see that *Spot Elevation 450* lies midway between the three and four mark on the coordinate scale. By applying the above rounding-off rule, round up to read this number as 434. Next, combine both sets of numbers and add the 100,000 meter square identifier to give you the location of YF116434. You have now correctly located a point to the nearest 100 meters by using a coordinate scale.

GRID REFERENCE BOX

The grid reference box found on topographic map sheets contains step-by-step instructions for using the grid and military grid reference systems. Mapmakers divide the grid reference box into two parts (see Illustration 2.2.1).

The left portion identifies the grid zone designation and the 100,000 meter square identifier. If the map sheet falls in more than one 100,000 meter square, the number of the grid line that separates these squares and the 100,000 meter square identifications are given. The right portion briefly explains how to find and write a six-digit coordinate.

CONCLUSION

Being successful at map reading requires a thorough understanding of many basic concepts. This chapter has presented several precise systems of finding locations on maps. Your ability to use these systems and to locate four-and six-digit grid coordinates can increase your confidence in identifying your location.

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